

Claims

1. A heat exchange tube bundle for regulating the
5 temperature of an intake air mixture and of
recirculated exhaust gases entering an internal
combustion engine of a motor vehicle, comprising a feed
air cooler (2) and a recirculated exhaust gas cooler
(4), the feed air cooler comprising a feed air inlet
10 manifold (34) and a feed air outlet manifold (36), a
feed air inlet line (38) being connected to the inlet
manifold (34), and a feed air outlet line (40) to the
outlet manifold (36) of the feed air cooler, the
recirculated exhaust gas cooler (4) comprising a
15 recirculated exhaust gas inlet manifold (74) and a
recirculated exhaust gas outlet manifold (76), a
recirculated exhaust gas inlet line (42, 68) being
connected to the inlet manifold (74) of the
recirculated exhaust gas cooler,

20 characterized in that it comprises a first bypass (52,
66) directly connecting the inlet manifold (74) to the
outlet manifold (76) of the recirculated exhaust gas
cooler (4), and incorporated in the heat exchange tube
25 bundle.

2. The heat exchange tube bundle as claimed in
claim 1, characterized in that it comprises a second
bypass (52, 62) directly connecting the inlet manifold
30 (34) to the outlet manifold (36) of the feed air cooler
(2) and incorporated in the heat exchange tube bundle.

3. The heat exchange tube bundle as claimed in
either of claims 1 and 2, characterized in that it
35 comprises first distribution means (56, 70, 72, 80) for
distributing the recirculated exhaust gases between the
recirculated exhaust gas cooler (4) and the first
bypass (52, 66).

4. The heat exchange tube bundle as claimed in either of claims 2 and 3, characterized in that it comprises second distribution means (58, 60, 92) for distributing the feed air between the feed air cooler
5 (2) and the second bypass (52, 62).

5. The heat exchange tube bundle as claimed in claims 3 and 4, characterized in that it comprises control means (180) connected to the first and second
10 distribution means for adjusting the proportion of cooled or heated inlet gases, inlet gases which have been neither cooled nor heated, cooled recirculated exhaust gases and recirculated exhaust gases which have been neither cooled nor heated, according to a
15 predefined law.

6. The heat exchange tube bundle as claimed in one of claims 2 to 5, characterized in that the first and second bypasses are different and separate from one
20 another.

7. The heat exchange tube bundle as claimed in one of claims 2 to 5, characterized in that the first and second bypasses are merged in a single bypass (52).
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8. The heat exchange tube bundle as claimed in one of claims 1 to 7, characterized in that it comprises at least one proportional valve (80), for example a rotary valve, for managing both the intake air flow rate and
30 the recirculated exhaust gas flow rate, and also the temperature of the intake mixture.

9. The heat exchange tube bundle as claimed in one of claims 4 to 8, characterized in that the bypasses
35 and intake air and recirculated exhaust gas distribution means constitute a submodule added on to the heat exchange tube bundle.

10. The heat exchange tube bundle as claimed in one of claims 1 to 9, characterized in that the inlet (38) of the intake air in the inlet manifold (34) of the feed air cooler (2) and the outlet (40) of this feed
5 air, optionally mixed with the recirculated exhaust gases, from the outlet manifold (36) of the feed air cooler, are located along the same side of the module.

11. The heat exchange tube bundle as claimed in one
10 of claims 1 to 9, characterized in that the inlet (38) of the feed air in the inlet manifold (34) of the feed air cooler and the outlet (40) of this feed air, optionally mixed with the recirculated exhaust gases, from the outlet manifold (36) of the feed air cooler
15 (2), are located on different sides of the module.

12. The heat exchange tube bundle as claimed in one of claims 1 to 11, characterized in that the circulation of the recirculated exhaust gases in the
20 recirculated exhaust gas cooler (4) takes place in two passes along a U route.

13. The heat exchange tube bundle as claimed in one of claims 1 to 12, characterized in that a recirculated
25 exhaust gas inlet line (68) is connected to the outlet manifold (76) of the recirculated exhaust gas cooler (4), the latter constituting the first bypass (66), the cooler (4) comprising a transfer channel (75) to convey the fraction of the recirculated exhaust gases to be
30 cooled to the inlet manifold (74); a valve (80) being arranged at the junction of the outlet manifold (76) and the transfer channel (75) to distribute the recirculated exhaust gases between the outlet manifold (76) and the transfer channel (75).

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14. The heat exchange tube bundle as claimed in one of claims 1 to 13, characterized in that it comprises a sensor (86) of the intake air temperature located in a zone (84) of the outlet manifold (36) of the feed air

cooler which is not traversed by the recirculated exhaust gases.

15. The heat exchange tube bundle as claimed in claim 14, characterized in that the recirculated exhaust gas cooler (4) has a length that is shorter than the length of the feed air cooler (2) so as to arrange a zone (84) of the outlet manifold of the feed air cooler which is not traversed by the recirculated exhaust gases.

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16. The heat exchange tube bundle as claimed in one of claims 1 to 15, characterized in that the feed air cooler (2) comprises a recirculated exhaust gas deflector (87) arranged facing the outlet (78) of the recirculated exhaust gases in order to deviate these gases toward the outlet manifold (36) of the feed air cooler (2).

17. The heat exchange tube bundle as claimed in one of claims 1 to 16, characterized in that the recirculated exhaust gases pass from the outlet manifold (76) of the recirculated exhaust gas cooler (4) into the outlet manifold (36) of the feed air cooler (2) via an outlet orifice (78) of which the cross section is smaller than or equal to the flow area for the gases in the recirculated exhaust gas cooler (4).

18. The heat exchange tube bundle as claimed in one of claims 1 to 16, characterized in that the recirculated exhaust gases pass from the outlet manifold (76) of the recirculated exhaust gas cooler (4) into the outlet manifold (36) of the feed air cooler (2) via an outlet orifice (78) of which the cross section is larger than the flow area for the gases in the recirculated exhaust gas cooler (4) and in that the outlet manifold (76) of the recirculated exhaust gas cooler (4) and the outlet manifold (36) of

the feed air cooler (2) are connected to each other by a divergent part (87).

19. The heat exchange tube bundle as claimed in one
5 of claims 1 to 18, characterized in that the recirculated exhaust gases flow directly into the outlet manifold (36) of the feed air cooler (2), this manifold functionally playing the role of an outlet manifold for the recirculated exhaust gas cooler (4).